

Interactive comment on “Field test of available methods to measure remotely SO₂ and NO_x emissions from ships” by J. M. Balzani Lööv et al.

J. M. Balzani Lööv et al.

jens.hjorth@jrc.ec.europa.eu

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We would like to thank both of the reviewers for their useful comments and suggestions. In the following are listed the changes of the paper that were made to meet the reviewers requests. For each point, the final page and line numbers are those of the corrected version while the first page and line numbers are those of the version that the referee refers to.

Referee 1:

Page 14, line 22 – 23: Decimal separator has been inserted. (P. 13, line 4-5).

1) Page 22, lines 23 – 25: The text on this point was incomplete. It has now been made

C4868

clear that the emissions from the auxiliary engines, using MDO, are not measured by the on-board stack measurements. (P. 20, line 13): “The on-board stack measurements within the harbour gave values of FSC (1.2 % (m/m) with a standard deviation of 0.15 % (m/m)) that were not significantly different from those obtained on the open sea, however, the contribution from the two auxiliary engines running on MDO with lower sulphur content was not measured on-board.”

2) Conclusion: we have now underlined the relatively good agreement between the sniffer measurements in the first paragraph of the conclusion. (P. 24, line 23-25).

“The results of the FSC measurements based on the sniffer principle from land (0.86±0.23 % (m/m)), from stack (1.2 ±0.15 % (m/m)) and from a mobile platform: (1.13±0.18 % (m/m)) showed agreement within the uncertainty limits.”

3) We agree that the evaluation of the uncertainty on the sniffer measurements is important. We have thus added a paragraph with some more information, including the results of a “propagation of error” calculation, as suggested by the referee. (P. 19, line 16-22)

“The average relative standard deviation on the determination of FSC values by the sniffer method during this campaign was estimated by Alföldy et al. (2013) to be 23% by comparing repeated determinations of emissions from the same ship. The uncertainty on the determination of the NO_x emission factor (in g per kg fuel) was found in the same way to be 26%. These estimates are close to those of 20 and 24% for the SO₂ and NO_x emissions factors respectively, found by Beecken et al. (2014) as the square root of the sum of all squared uncertainties due to calibrations and measurements for the respective gas species and CO₂.”

Concerning the idea of using the measurements of FSC at around 0.1 % (m/m) to estimate the uncertainty: With the relatively few points that are available, the calculation of the standard deviation will depend very much on which points we decide to consider to be ‘close to 0.1’ and the criteria we apply for eliminating outliers. Thus we find that

C4869

we do not have a sound basis for doing this kind of estimate.

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C4870